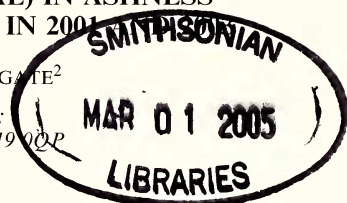


# A STUDY OF THE WOOD ANT *FORMICA LUGUBRIS* ZETTERSTEDT (HYMENOPTERA: FORMICIDAE) IN ASHNESS WOODS, BORROWDALE, CUMBRIA, ENGLAND IN 2001

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## ABSTRACT

A survey in 2001 of 198 *Formica lugubris* nests in a partly coniferised broadleaf woodland in Ashness Woods, Borrowdale, is described, with some additional work in 2003. Nests were found to be most commonly up to 1 m in diameter, but a wide range of sizes up to 9 m was recorded, the latter being much larger than the maximum found for *Formica rufa* L. in north west England. The density of nests was estimated at 5.7 per ha which is higher than had been found for *F. rufa* but was judged to be typical for an established population. The use of oak and conifers as forage trees was found to be about equal; birch was another important tree, but ash and hazel were little used; they probably avoided these trees. The nest sites were not found to be associated with particular tree species. It is noted that, unlike the Duddon valley where *F. lugubris* is widespread, the Ashness population is confined to two discrete groups which only occupy a small part of the available woodland. It is suggested that this ant has only been established in the Ashness Woods relatively recently and the possibility that it may have been introduced is considered. Implications of current management for the ant's conservation are considered and concluded to be beneficial.

## INTRODUCTION

*Formica lugubris* Zetterstedt, the 'northern hairy wood ant', is an upland relative of *Formica rufa* L., the 'southern red wood ant'. In Europe it is found from Scandinavia in the north to Bulgaria and Italy in the south, and eastwards through France and Germany to Russia. In Britain it occurs in mainly upland situations in Scotland and North Wales, and in England in the Pennines, Northumbria, North Yorkshire Moors and Cumbria. Figure 1 shows its distribution as mapped by the Bees, Wasps and Ants Recording Society in 2002 (Edwards & Telfer, 2002). In Cumbria it is confined to the Lake District valleys of Borrowdale and the Duddon – figure 2 shows its distribution by tetrads and illustrates the separation of the northern population in Borrowdale (the subject of this study) from the much more extensive population in the Duddon Valley. Physically, it is only distinguished from *F. rufa* by the presence of minute hairs between the facets of its eyes and on the head and prothorax, but it is quite different in its colony structure and ecology. *Formica rufa* typically inhabits single nests (i.e. is monodomous) whereas *F. lugubris* colonies usually have a group of interconnected satellite nests around the main nest (polydomous). Many of the individual nests are small, but some very large nests are also formed. *Formica lugubris* is an upland species; in Europe it occurs in montane situations, up to and above the treeline (C.A. Collingwood, pers. comm., N.A.R. obs.). The fact that it occurs in the Lake District, in places with nearly the highest rainfall in England, shows that it is tolerant of extremely wet conditions. In contrast, *F. rufa* is a lowland species. The northern limit of its range in England is now along the southern edge of Cumbria in the Arnside-Silverdale Area of Outstanding Natural

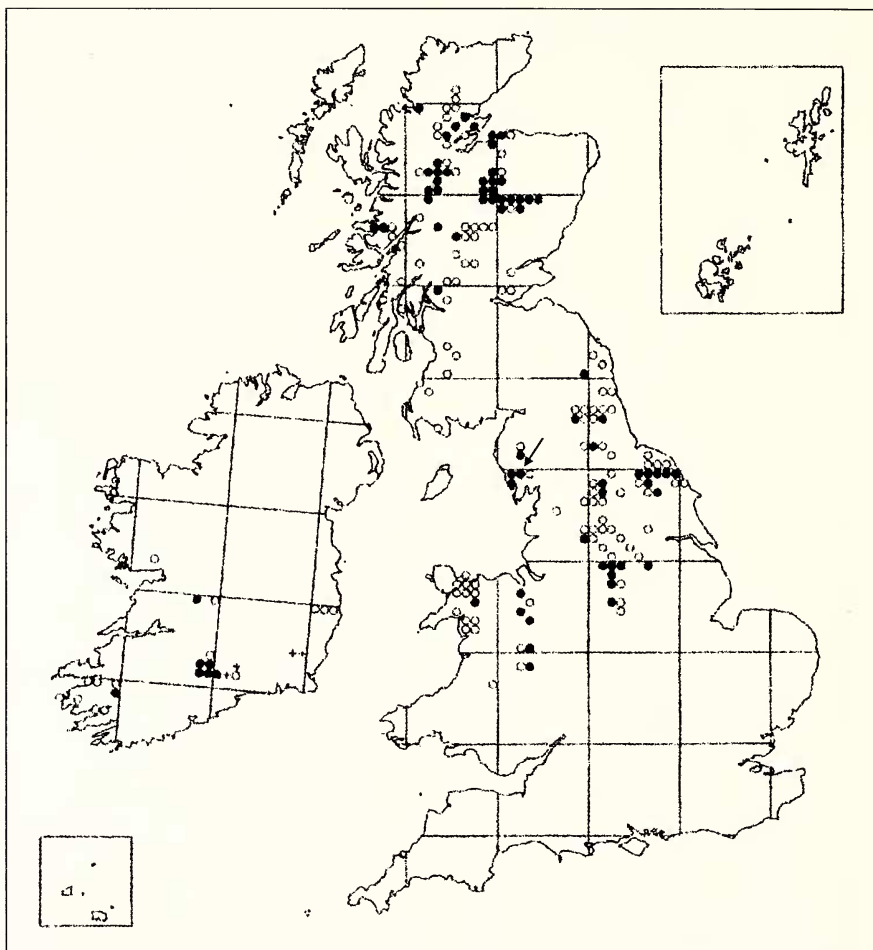


Fig. 1. Distribution of *Formica lugubris* in Britain by 10-km squares. +, before 1900; open circles, 1900–1969; closed circles, 1970–March 2002. Arrow indicates study region.

Beauty (Robinson, 2001) so the ranges of these two species do not overlap in the county.

In 2001, Jessica Woodgate carried out a survey of *F. lugubris* nests in the parts of the Ashness Woods owned by the Trust (Woodgate, 2001). In 2003 some further work was carried out (N.A.R.) recording nests outside the Trust property so that the study could report on the whole population.

### The woodland

The woodlands which are the subject of this study are known by a variety of names. For the purposes of this account they are referred to as Ashness Woods, the

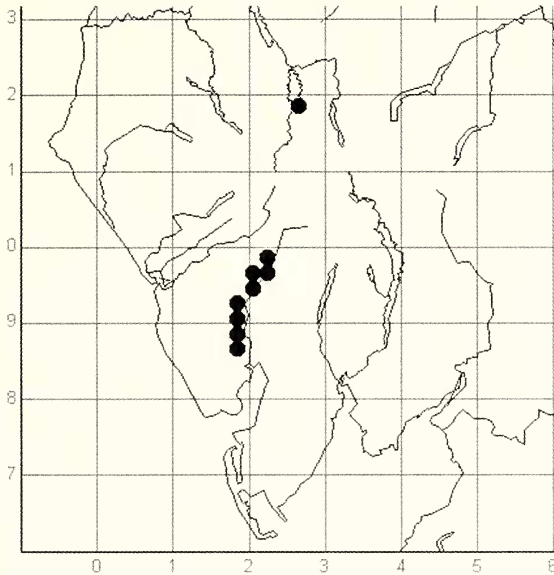


Fig. 2. Distribution of *Formica lugubris* in south-west Cumbria mapped by tetrads.

name by which they are most popularly known by their association with Ashness Bridge, one of the most famous viewpoints in the Lake District. They are located in OS 1 km square NY2010, in the ravine of Watendlath Beck, in the mouth of a classic glacial hanging valley overlooking Derwentwater. They constitute the northern c. 35 ha extremity of the 370 ha Lodore-Troutdale Site of Special Scientific Interest (SSSI). Together with the other SSSIs in the Borrowdale Woodland complex, and Scales Wood at Buttermere, it is proposed as a candidate Special Area of Conservation (SAC) under the Habitats Directive of the European Union. The primary interest of these sites is their extensive Atlantic sessile oak woodlands (National Vegetation Classification W17). They lie on rocks of the Borrowdale Volcanics and Skiddaw Slates. These produce mainly acid soils on which sessile oak *Quercus petraea* (Matt.) Liebl. is the dominant tree, with varying amounts of birch *Betula* spp. and rowan *Sorbus aucuparia* L., under which wavy hair-grass *Deschampsia flexuosa* (L.) Trin., bilberry *Vaccinium myrtillus* L. and bracken *Pteridium aquilinum* (L.) Kuhn predominate, with a rich bryophyte flora.

The part of the site owned by the National Trust lies in the altitudinal range of c. 140–250 m OD. Although predominantly sessile oak woodland, parts have been considerably modified through past management by the introduction of beech *Fagus sylvatica* L., sycamore *Acer pseudoplatanus* L., horse chestnut *Aesculus hippocastanum* L. and conifers: pine *Pinus sylvestris* L., spruce *Picea* sp. and larch *Larix decidua* Mill.—the latter in some places as solid plantations, elsewhere as underplanting. Current management by the National Trust has seen the enclosure of some areas in order to reduce sheep grazing and to encourage natural regeneration of native broadleaves, and the progressive removal of non-native species. The Trust hopes to have removed all of the planted conifers by 2005. Management will then follow the lines of limited intervention.

## METHODS

### The 2001 Survey

The aims of the survey were to try to find out more about the ecology of the ants, how they were influenced by the surrounding woodland and why in particular the ants were in Ashness Woods, as their population appeared to be restricted to this woodland.

An area of about 35 ha (Fig. 3) was covered by means of transects walked north-south at 20 m intervals, recording 10 m on each side. To assist the survey the woodland was divided into named units and the following recorded:

- i) Location – i.e. name of woodland unit.
  - ii) The length of the longest axis (i.e. maximum width of base) of the main nest.
  - iii) The height of the nest mound.
  - iv) The nearest four tree species.
  - v) Whether the nest was active (judged to be active if ants were seen moving around on the surface).
  - vi) Which tree species the ants were utilising.
  - vii) Ten figure grid reference (from a hand-held Global Positioning Satellite receiver).
- Because it was not possible to differentiate GPS readings for the individual nests in a group, only one grid reference, the main nest, was noted for each colony. These were used to map the locations of the colonies.

### The 2003 Survey

On 14 March, a survey was carried out (N.A.R. with David Thomason) to find whether the population extended into the woodlands outside the National Trust boundary. Seven nests were found outside the foot of the wall of Mossmire Coppice but it was judged that these were satellites of nests which had been mapped previously inside the Coppice. A total of 14 large nests were found on Shepherds Crag, seven on the east side right on the lip of the ravine, and seven nests on the west side on less sheer slopes. With the addition of two nests not previously recorded on the Trust property, this raised the total number of nests to 214, but it confirmed that the bulk of the population was on the Trust property and that the the Trust survey was representative of it.

## RESULTS AND DISCUSSION

### Size and distribution of the populations

During the survey in 2001 the locations of 198 colonies (i.e. 'main' nests, not satellites) of *F. lugubris* were accurately mapped by GPS (Woodgate, op. cit). They were situated in two discrete populations, separated by a distance of about 600 m. The lower one extended from the bottom of the woodland uphill to Ashness Bridge, where there were nests beside the adjacent car park. After a gap of about 600 m, the other, larger, population began close to the car parks for Surprise View, an equally famous viewpoint, and extended through the woods on both sides of the road to the limit of the woodland on the east and onto Shepherds Crag on the west. The fact that the two populations were separated and so limited in extent is a point of interest which is considered in more detail below. C.A. Collingwood recalls having seen a single *F. lugubris* nest in 1973 in Great Wood at NY272214, c. 1.5 km to north, but no nests are present there now.





Table 1. Distribution of *Formica lugubris* nests by basal diameter classes

	Nest diameter (m) ( <i>n</i> = 196)								
	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9
No. of nests	66	42	35	18	16	9	8	1	1

Table 2. Distribution of *Formica lugubris* nests by height classes

	Nest height (m) ( <i>n</i> = 195)					
	0-0.5	0.6-1	1.1-1.5	1.6-2	2.1-2.5	2.6-3
No. of nests	56	57	54	16	11	1

Silverdale AONB (N.A.R. obs.). It was noted that these larger nests tended to be situated high up on rocky outcrops.

Even by the end of the season when nests were usually at their largest, 86% were less than 1.5 m tall, with a mean height of 0.76 m (Table 2). The relationship between nest height and diameter in wood ant nests is complex, being influenced *inter alia* by age, shade (in which mounds are usually higher), time of year (nests are often demolished or flattened during the winter and reconstructed by the end of the summer) and slope, so no analysis of this feature was attempted in the study.

### Nest density

The area in which 198 nests were recorded in 2001 was estimated at 35 ha, which gives a colony density of 5.7 per ha. This is higher than an estimate of 4.3 per ha made for *F. rufa* nests in Gait Barrows National Nature Reserve (N.A.R. unpublished). Estimates of nest density are inevitably somewhat arbitrary due to the difficulty of measuring the areas occupied by populations which do not have clear boundaries. A study of 326 occupied nests of *F. lugubris* in 202 ha of Forestry Commission plantation in Langdale Forest, North Yorkshire in 1972 (Sudd *et al.*, 1977) gave an overall density of 1.6 nests per ha. However, densities ranged from about 1 per ha in plantations, where nests were confined to the edges, to 5.5 per ha in more natural areas which included gills and scrub. A study of populations in Wales (Hughes, 1975) found that the highest densities occurred in semi-natural woodlands where boulders caused spacing of the trees so that about one third of the woodland floor received direct sunlight, and in some revegetated ex-industrial sites with similar conditions. In Europe, densities of 3-6 nests per ha have been found in the Northern Alps (Sudd *et al.*, 1977). It seems that in Central Europe at altitudes around 1000 m, *F. lugubris* can occur at densities around 5 per ha, and that densities of this order can be found at altitudes of 150 m and lower in northern England (Sudd *et al.*, 1977). From this it appears that the nest density in Ashness Woods is typical of well established populations.

Table 3. Trees usage by *Formica lugubris* and nearest trees to colonies

	Oak	Conifer	Birch	Ash	Hazel
No. used	94	92	62	2	1
Nearest to colonies	139	100	91	46	15

Trees usage and association of colonies with trees

Wood ants forage mainly by making trails up trees where they ‘milk’ aphids for honeydew and collect small invertebrate prey. Oak was the most frequently used at 37.5%, but conifers at 36.7% were equally important (Table 3). Birch was also a valuable tree, but ash *Fraxinus excelsior* L. and hazel *Corylus avellana* L. were very little visited and probably avoided. That conifers were found to be collectively of equal value to oak equates with the fact that *F. lugubris* is known to occur in both conifer and broadleaved woodland. The four nearest trees to each main nest were recorded. Table 3 shows the results, which appear to reflect quite closely the proportions of species in the woodland. Sudd *et al.* (1977) also found that nests were associated with most crop trees and wild trees present, but were most abundant near to plantation margins and regenerating natural scrub.

The origin of the populations

Two immediately striking features of these populations are that they are separated by a short (600 m) length of apparently suitable habitat and that they only occupy such a small part of the available woodland.

The area occupied by these populations is only about 9.5% of the 370 ha Lodore-Troutdale SSSI, and an even smaller part (c. 6%) of the Borrowdale Woods as a whole. In contrast, in the Duddon valley *F. lugubris* is present throughout the woodlands from Furnace Wood at the mouth right up to Dunnerdale Forest above Seathwaite, a distance of about 14 km. They are so abundant in roadside woods near Seathwaite that they have been observed emerging and establishing nests on the verges (N.A.R. obs., September 2002). If they had been in Borrowdale as long as they have been in the Duddon it is reasonable to suppose that they would be as widespread as they are in the Duddon. This suggests that they were established in the Ashness Woods relatively recently, and raises the possibility that they may have been introduced. The existence of a nest in Great Wood, where there has been no known population, suggests that it could have been the survivor of an introduction. The earliest record of wood ants in Ashness Woods is in 1907 by F.H. Day, whose specimens are in Tullie House Museum, Carlisle. Sudd *et al.* (1977) studied a population which they believed had colonised Forestry Commission plantings after they began in 1920. The largest nest diameter which they recorded was about 1.5 m. The commonest nest diameter in plantings before 1945 was 0.6–0.8 m, and the commonest after 1945 was 0.2–0.4 m. The much larger diameters recorded in Ashness Woods suggest an earlier origin, i.e. 19th century at least. There appear to be three ways by which this might have happened:

- (i) Natural colonisation from the Duddon populations,
- (ii) Accidental or deliberate introduction through forestry,
- (iii) Deliberate introduction to feed pheasants.

Considering these in turn: Hughes (1975) cites the case of a population which had developed on an old mine site at Snailbeach in West Shropshire and concludes that *F. lugubris* is capable of dispersion of 32 km from the nearest source. The nearest population in the Duddon Valley is about 18 km from Ashness Woods which is well within this range, but as they are also separated by the highest mountains in England, rising to almost 1000 m, it seems unlikely that they reached Borrowdale of their own accord. Furthermore, the so-called guest ant *Formicoxenus nitidulus* (Nylander) which inhabits wood ant nests and is known in the Duddon, was found in a nest in Ashness Woods by F.H. Day in 1907. It is unlikely to have been conveyed by a flying queen.

Introduction of plants with conifers is known to have occurred. At Ainsdale Sand Dunes NNR very localised patches of common wintergreen *Pyrola minor* L. and lesser twayblade *Listera cordata* (L.) R.Br., which do not occur in the sand dunes, have been found in the 20th century pine plantations. *Formica lugubris* occurs in many Forestry Commission plantations. In some cases it is known to have invaded them from pre-existing populations (Sudd *et al.*, 1977). On the Continent wood ants are believed to be of value in forestry for controlling defoliating insects and have been translocated widely for this purpose (Sudd *et al.*, 1977, Zahradnik, 1991). However, the present authors are not aware of any cases in Britain where wood ants are known to have been introduced deliberately for the benefit of forestry.

The practice of introducing wood ant nests into pheasantries with the objective of feeding the brood to the chicks was widespread in Victorian (and possibly earlier) times. A survey of *F. rufa* and *F. lugubris* in the Lake District in the 1950s (Satchell & Collingwood, 1955) found some written, and much anecdotal, evidence that *F. rufa* had been introduced into pheasantries in the centre of the Lake District, presumably from estates along the southern edge where there were populations of this species. Their paper reported only one case of an apparent attempt to translocate *F. lugubris*—an unsuccessful one from the Duddon to the Grizedale Estate. In 1971 another such translocation was attempted (J. Cubby pers. comm.), when the Forestry Commission moved several nests with a number of queens in plastic dustbins from Rainsbarrow Wood in the Duddon to Grizedale Forest to feed Capercaillie *Tetrao urogallus* L. which it was also attempting to introduce, but neither the ants nor the birds became established. There does not seem to be, however, any reason in principal why *F. lugubris* should not be capable of being translocated, e.g. from the Duddon to Ashness Woods. Up to the time of writing (July 2003), no information had been traced about the previous ownership or management of Ashness Woods which would indicate whether the estate was in the kind of intensive sporting management which might have involved introducing wood ants.

### Conservation considerations

The current woodland management operations may affect the wood ants by damaging their nests, altering the woodland composition and removing their forage trees. During felling in 2002 one of the largest nests was demolished and covered with brush. However, *F. lugubris* is not intimidated by this sort of treatment and was observed in 2003 to have responded by rebuilding its nest up and over the material which had been dumped upon it. The increased admission of light in a patchy fashion is likely to benefit the ants since, as in *F. rufa*, populations seem to be most vigorous where there is a patchwork of light and shelter, and tend to become static under closed canopy. The conifers being removed will inevitably include some forage trees, but, as the ants must have been present in the woodland before coniferisation, they



presumably will re-adapt to its restored condition. It is anticipated that the current management should, on balance, be beneficial to the ants, or, at least, not deleterious.

#### ACKNOWLEDGEMENTS

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#### SHORT COMMUNICATION

***Sphegina sibirica* Stackelberg (Diptera: Syrphidae) in West Sussex.**—During 2002 I was surveying a small deciduous woodland block just south of Fernhurst (Newlands Copse) at SU876295 for the Cowdray Estate. On the 25 May I collected a number of individuals of *Sphegina* species from *Torilis* sp. (Hedge Parsley) growing in dappled shade at the eastern edge of the wood and one from the interface between the deciduous woodland and a block of mature *Picea abies* (Norway Spruce) on the western boundary. Seven of these proved to be *Sphegina chunipes* (Fallén), and one was a female *Sphegina sibirica*. The possible association with *Picea* has been reported at other locations where this species has been found (Ball & Morris 2000, *Provisional Atlas of British Hoverflies* (Diptera, Syrphidae), BRC). This is the first record for this species from south-eastern England (A. Stubbs, pers. comm.). It was added to the British list by Alan Stubbs in 1994 from a Scottish specimen found in 1992 and has since been found in a number of locations in Scotland and on the Welsh borders. — MIKE EDWARDS, Lea-side Carron Lane, Midhurst, West Sussex, GU29 9LB